

**METHOD AND APPARATUS FOR ENHANCEMENT OF WEB SEARCHES****BACKGROUND OF THE INVENTION****1. Technical Field:**

The present invention relates generally to an improved data processing system, and in particular to a method and apparatus for processing data. Still more particularly, the present invention provides a method, apparatus, and computer instructions for processing a Web page returned from a search.

**10 2. Description of Related Art:**

The Internet, also referred to as an "internetwork", is a set of computer networks, possibly dissimilar, joined together by means of gateways that handle data transfer and the conversion of messages from a protocol of the sending network to a protocol used by the receiving network. When capitalized, the term "Internet" refers to the collection of networks and gateways that use the TCP/IP suite of protocols.

The Internet has become a cultural fixture as a source of both information and entertainment. Many businesses are creating Internet sites as an integral part of their marketing efforts, informing consumers of the products or services offered by the business or providing other information seeking to engender brand loyalty. Many federal, state, and local government agencies are also employing Internet sites for informational purposes, particularly agencies which must interact with virtually all segments of society such as the Internal Revenue Service and secretaries of state. Providing informational

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guides and/or searchable databases of online public records may reduce operating costs. Further, the Internet is becoming increasingly popular as a medium for commercial transactions.

5           Currently, the most commonly employed method of transferring data over the Internet is to employ the World Wide Web environment, also called simply "the Web". Other Internet resources exist for transferring information, such as File Transfer Protocol (FTP) and Gopher, but have  
10 not achieved the popularity of the Web. In the Web environment, servers and clients effect data transaction using the Hypertext Transfer Protocol (HTTP), a known protocol for handling the transfer of various data files (e.g., text, still graphic images, audio, motion video,  
15 etc.). The information in various data files is formatted for presentation to a user by a standard page description language, the Hypertext Markup Language (HTML). In addition to basic presentation formatting, HTML allows developers to specify "links" to other Web  
20 resources identified by a Uniform Resource Locator (URL). A URL is a special syntax identifier defining a communications path to specific information. Each logical block of information accessible to a client, called a "page" or a "Web page", is identified by a URL. The URL  
25 provides a universal, consistent method for finding and accessing this information, not necessarily for the user, but mostly for the user's Web "browser". A browser is a program capable of submitting a request for information identified by an identifier, such as, for example, a URL.  
30 A user may enter a domain name through a graphical user interface (GUI) for the browser to access a source of content. The domain name is automatically converted to

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the Internet Protocol (IP) address by a domain name system (DNS), which is a service that translates the symbolic name entered by the user into an IP address by looking up the domain name in a database.

5        Various search engines are available on the Web for use by users to locate Web pages of interest. A user enters keywords relating to a subject matter of interest to the user. These keywords form a search query which is sent to the search engine. A set of results is returned  
10 to the user. These results are often a set of links in a Web page. The user may then select a link to view a Web page matching the search query. In reviewing the Web page, the user may desire to review a portion or section of the page containing the keywords. One problem  
15 encountered by the user is that the user must manually activate a "find" function to identify keywords in the Web page. Although such an activity is not extremely difficult, performing these extra steps may cause the user to lose focus on the subject or slow down the review of  
20 the results. These extra steps may be time consuming depending on the number of Web pages returned for review by the user.

Therefore, the present invention provides an improved method, apparatus, and computer instructions for allowing  
25 a user to quickly focus on a section of interest in a Web page.

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### SUMMARY OF THE INVENTION

The present invention provides a method, apparatus, and computer instructions for processing a Web page. A search query is sent from a browser to a search engine in which the search query includes a search term. The Web page is received in response to sending the query including a search term. Each instance of the search term present in the Web page is highlighted.

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**BRIEF DESCRIPTION OF THE DRAWINGS**

The novel features believed characteristic of the invention are set forth in the appended claims. The invention itself, however, as well as a preferred mode of use, further objectives and advantages thereof, will best be understood by reference to the following detailed description of an illustrative embodiment when read in conjunction with the accompanying drawings, wherein:

**Figure 1** depicts a pictorial representation of a network of data processing systems in which the present invention may be implemented;

**Figure 2** is a block diagram of a data processing system that may be implemented as a server in accordance with a preferred embodiment of the present invention;

**Figure 3** is a block diagram illustrating a data processing system in which the present invention may be implemented;

**Figure 4** is a diagram illustrating data flow in enhancing a Web search in accordance with a preferred embodiment of the present invention;

**Figure 5** is a block diagram of a browser program in accordance with a preferred embodiment of the present invention;

**Figures 6A and 6B** are diagrams illustrating tags used to highlight search terms in accordance with a preferred embodiment of the present invention; and

**Figure 7** is a flowchart of a process used to highlight search terms in a Web page in accordance with a preferred embodiment of the present invention.

**DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT**

With reference now to the figures, **Figure 1** depicts a pictorial representation of a network of data processing systems in which the present invention may be implemented.

5 Network data processing system **100** is a network of computers in which the present invention may be implemented. Network data processing system **100** contains a network **102**, which is the medium used to provide communications links between various devices and computers  
10 connected together within network data processing system **100**. Network **102** may include connections, such as wire, wireless communication links, or fiber optic cables. In the depicted example, server **104** is connected to network **102** along with storage unit **106**. In addition,  
15 clients **108**, **110**, and **112** are connected to network **102**. These clients **108**, **110**, and **112** may be, for example, personal computers or network computers. In the depicted example, server **104** provides data, such as boot files, operating system images, and applications to clients  
20 **108-112**. In particular, server **104** may provide Web pages to the clients in response to receiving requests containing search queries. These Web pages may be located at server **104** or at storage unit **106**. The process of the present invention provides a mechanism to allow a user to  
25 quickly focus on a section of interest within a Web page identified in a set of results in response to a query. In these examples, the mechanism is located in the client, such as client **108**, **110**, or **112**. Network data processing system **100** may include additional servers, clients, and  
30 other devices not shown.

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In the depicted example, network data processing system **100** is the Internet with network **102** representing a worldwide collection of networks and gateways that use the TCP/IP suite of protocols to communicate with one another.

5 At the heart of the Internet is a backbone of high-speed data communication lines between major nodes or host computers, consisting of thousands of commercial, government, educational and other computer systems that route data and messages. Of course, network data  
10 processing system **100** also may be implemented as a number of different types of networks, such as for example, an intranet, a local area network (LAN), or a wide area network (WAN). **Figure 1** is intended as an example, and not as an architectural limitation for the present invention.

15 Referring to **Figure 2**, a block diagram of a data processing system that may be implemented as a server, such as server **104** in **Figure 1**, is depicted in accordance with a preferred embodiment of the present invention. Data processing system **200** may be a symmetric  
20 multiprocessor (SMP) system including a plurality of processors **202** and **204** connected to system bus **206**. Alternatively, a single processor system may be employed. Also connected to system bus **206** is memory controller/cache **208**, which provides an interface to local  
25 memory **209**. I/O bus bridge **210** is connected to system bus **206** and provides an interface to I/O bus **212**. Memory controller/cache **208** and I/O bus bridge **210** may be integrated as depicted.

Peripheral component interconnect (PCI) bus bridge  
30 **214** connected to I/O bus **212** provides an interface to PCI local bus **216**. A number of modems may be connected to PCI

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Those of ordinary skill in the art will appreciate that the hardware depicted in **Figure 2** may vary. For example, other peripheral devices, such as optical disk drives and the like, also may be used in addition to or in place of the hardware depicted. The depicted example is not meant to imply architectural limitations with respect to the present invention.

With reference now to **Figure 3**, a block diagram illustrating a data processing system is depicted in which the present invention may be implemented. Data processing system **300** is an example of a client computer. Data processing system **300** employs a peripheral component



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interconnect (PCI) local bus architecture. Although the depicted example employs a PCI bus, other bus architectures such as Accelerated Graphics Port (AGP) and Industry Standard Architecture (ISA) may be used.

5 Processor **302** and main memory **304** are connected to PCI local bus **306** through PCI bridge **308**. PCI bridge **308** also may include an integrated memory controller and cache memory for processor **302**. Additional connections to PCI local bus **306** may be made through direct component  
10 interconnection or through add-in boards. In the depicted example, local area network (LAN) adapter **310**, SCSI host bus adapter **312**, and expansion bus interface **314** are connected to PCI local bus **306** by direct component connection. In contrast, audio adapter **316**, graphics  
15 adapter **318**, and audio/video adapter **319** are connected to PCI local bus **306** by add-in boards inserted into expansion slots. Expansion bus interface **314** provides a connection for a keyboard and mouse adapter **320**, modem **322**, and additional memory **324**. Small computer system interface  
20 (SCSI) host bus adapter **312** provides a connection for hard disk drive **326**, tape drive **328**, and CD-ROM drive **330**. Typical PCI local bus implementations will support three or four PCI expansion slots or add-in connectors.

An operating system runs on processor **302** and is used  
25 to coordinate and provide control of various components within data processing system **300** in **Figure 3**. The operating system may be a commercially available operating system, such as Windows 2000, which is available from Microsoft Corporation. An object oriented programming  
30 system such as Java may run in conjunction with the operating system and provide calls to the operating system

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from Java programs or applications executing on data processing system **300**. "Java" is a trademark of Sun Microsystems, Inc. Instructions for the operating system, the object-oriented operating system, and applications or  
5 programs are located on storage devices, such as hard disk drive **326**, and may be loaded into main memory **304** for execution by processor **302**.

Those of ordinary skill in the art will appreciate that the hardware in **Figure 3** may vary depending on the  
10 implementation. Other internal hardware or peripheral devices, such as flash ROM (or equivalent nonvolatile memory) or optical disk drives and the like, may be used in addition to or in place of the hardware depicted in **Figure 3**. Also, the processes of the present invention  
15 may be applied to a multiprocessor data processing system.

As another example, data processing system **300** may be a stand-alone system configured to be bootable without relying on some type of network communication interface,  
20 whether or not data processing system **300** comprises some type of network communication interface. As a further example, data processing system **300** may be a personal digital assistant (PDA) device, which is configured with ROM and/or flash ROM in order to provide non-volatile  
25 memory for storing operating system files and/or user-generated data.

The depicted example in **Figure 3** and above-described examples are not meant to imply architectural  
limitations. For example, data processing system **300**  
30 also may be a notebook computer or hand held computer in addition to taking the form of a PDA. Data processing system **300** also may be a kiosk or a Web appliance.

Turning next to **Figure 4**, a diagram illustrating data flow in enhancing a Web search is depicted in accordance with a preferred embodiment of the present invention. In this example, client **400** includes a  
5 browser **402**, which is employed by a user to generate a search query. The user may enter keywords into browser **402** to generate request **404**, which is sent to server **406** for processing by search engine **408**. These keywords are search terms used by search engine **408** to identify a set  
10 of results. Other types of search terms may be a phrase or sentence entered by a user. In these examples, the communication between client **400** and server **406** occurs using Hypertext Transfer Protocol (HTTP) although other protocols may be used depending on the particular  
15 implementation.

Upon receiving request **404**, search engine **408** may search for Web pages corresponding to the keywords in request **404**. Various well-known mechanisms may be used to determine what Web pages correspond sufficiently to be  
20 included in a set of results. For example, a Web page may be identified as a result if all of the keywords are present in the Web page. Alternatively, a Web page may be identified as a result if the keywords occur a certain number of times within the Web page. Additionally, A Web  
25 page may be identified as a result if the requested keyword is located in the Web page's following HTML tag:  
<meta name="keywords" content=" requested keyword ">.  
Search engine **408** may search for results in index database **410**, which in this example contains identifications of Web  
30 pages, which have been indexed for purposes of searching. An index, such as index database **410**, contains a searchable catalog of documents created by search engine

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software. Further, search engine **408** may search HTML pages database **412** for Web pages corresponding to the search results. In these examples, a Web page in the form of HTML page **414** is generated for return to browser **402** in client **400**. HTML page **414** contains a set of results, which may be a list of links to Web pages returned in the search performed by search engine **408**. HTML page is stored in local storage **416**. This Web page is displayed in browser **402** to the user. The user may select a Web page from the results in HTML page **414** to generate request **418**. This request is sent to the server identified by the URL in the link.

In this example, this server is the same server that performed the search, server **406**. This request is processed by Web page server **420**, which may retrieve a Web page from HTML page **414** or dynamically generate a Web page using Java server page (JSP) **422**. A JSP is an extension to the Java servlet technology from Sun that provides a simple programming vehicle for displaying dynamic content on a Web page. The JSP is an HTML page with embedded Java source code that is executed in the Web server or application server. The HTML provides the page layout that will be returned to the Web browser, and the Java provides the processing; for example, to deliver a query to the database and fill in the blank fields with the results. In this example, the information used to fill the HTML page is located in Web page data database **424**.

After the appropriate Web page is located or generated, HTML page **426** is returned to browser **402**. In these examples, browser **402** will parse HTML page **426** for keywords used in the search query sent in request **404**.

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Keywords identified within HTML page **426** are highlighted in the display of the page to the user to allow the user to quickly focus on the section of interest in HTML page **426**. These keywords are stored when the search query was  
5 initially sent in request **404** to search engine **408**.

Turning next to **Figure 5**, a block diagram of a browser program is depicted in accordance with a preferred embodiment of the present invention. A browser is an application used to navigate or view information or  
10 data in a distributed database, such as the Internet or the World Wide Web. Browser **500** is an example of browser **402** in **Figure 4**, which is used by a user to search for Web pages.

In this example, browser **500** includes a user  
15 interface **502**, which is a graphical user interface (GUI) that allows the user to interface or communicate with browser **500**. This interface provides for selection of various functions through menus **504** and allows for navigation through navigation **506**. For example, menu **504**  
20 may allow a user to perform various functions, such as saving a file, opening a new window, displaying a history, and entering a URL. Navigation **506** allows for a user to navigate various pages and to select web sites for viewing. For example, navigation **506** may allow a  
25 user to see a previous page or a subsequent page relative to the present page. Preferences such as those illustrated in **Figure 5** may be set through preferences **508**.

Communications **510** is the mechanism with which  
30 browser **500** receives documents and other resources from a network such as the Internet. Further, communications

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510 is used to send or upload documents and resources onto a network. In the depicted example, communication 510 uses HTTP. Other protocols may be used depending on the implementation. Documents that are received by browser 500 are processed by language interpretation 512, which includes an HTML unit 514 and a JavaScript unit 516. Language interpretation 512 will process a document for presentation on graphical display 518. In particular, HTML statements are processed by HTML unit 514 for presentation while JavaScript statements are processed by JavaScript unit 516. In these examples, HTML unit 514 includes the processes of the present invention. These processes are used to parse an HTML page to identify search terms, such as keywords, sentences, or phrases, which were entered by the user to form a search query. When a search term is identified in the HTML page, the search term is highlighted by adding a pair of tags to encompass the search term. In particular, one tag is placed before the search term and the other tag is placed after the search term. These tags are used to highlight or provide an emphasis for the search term when it is displayed by browser 500. These tags are inserted into a copy of the HTML page in a memory at the client, such as local storage 416 in Figure 4. In this manner, no alteration to the HTML page stored on the server is required. Further, this type of implementation provides an additional advantage because no changes are needed to the many different search engines presently used.

In these examples, although the mechanism of the present invention is implemented in HTML unit 514, these processes may be implemented in other ways. For example, a plug-in or a separate application may be used to

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process the HTML page. A plug-in is an auxiliary program that works with a software program to enhance its capability.

Graphical display **518** includes layout unit **520**,  
5 rendering unit **522**, and window management **524**. These units are involved in presenting web pages to a user based on results from language interpretation **512**.

Browser **500** is presented as an example of a browser program in which the present invention may be embodied.  
10 Browser **500** is not meant to imply architectural limitations to the present invention. Presently available browsers may include additional functions not shown or may omit functions shown in browser **500**. A browser may be any application that is used to search for and display  
15 content on a distributed data processing system. Browser **500** may be implemented using known browser applications, such as Netscape Navigator or Microsoft Internet Explorer. Netscape Navigator is available from Netscape Communications Corporation while Microsoft Internet  
20 Explorer is available from Microsoft Corporation.

Turning next to **Figures 6A** and **6B**, diagrams illustrating tags used to highlight search terms are depicted in accordance with a preferred embodiment of the present invention. In **Figure 6A**, the search term "apple"  
25 is encompassed by tag **600** and tag **602**. These tags will cause a search term to be highlighted by placing the search term in bold. Next in **Figure 6B**, tag **604** and tag **606** are placed around the search term "automobile" and provide highlighting in the form of causing this search  
30 term to be displayed in italics. Tags **600**, **602**, **604**, and **606** are also referred to as highlighting tags.

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These two examples are presented for purposes of illustration and are not intended to limit the manner in which a search term may be highlighted. For example, the search may be highlighted by using underlining, setting a font type, setting a color, setting a font size, or causing the search term to flash.

Turning next to **Figure 7**, a flowchart of a process used to highlight search terms in a Web page is depicted in accordance with a preferred embodiment of the present invention. The process illustrated in **Figure 7** may be implemented in a browser, such as browser **500** in **Figure 5**. More specifically, the process may be implemented in HTML unit **514**. Alternatively, for example, the process may be located in a plug-in for use with browser **500**.

The process begins by identifying a search request (step **700**). Search terms are stored (step **702**). These search terms, may be, for example, keywords, sentences, or phrases. The process waits for the HTML document to be received (step **704**). In this example, the process waits for an actual HTML document corresponding to the search request rather than the list of results. Search terms are selected from the search request (step **706**). The HTML document is parsed for a search term (step **708**).

Next, a determination is made as to whether the search term is found (step **710**). If the search term is found, highlighting tags are inserted around the search term (step **712**). Examples of these highlighting tags are illustrated in **Figure 6A** and **6B**.

A determination is then made as to whether parsing of the document is complete (step **714**). Parsing completes if the entire document has been searched for



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the search terms. If document parsing is complete, a determination is made as to whether additional search terms are present that have not been used in parsing the document (step **716**). If additional search terms are  
5 absent, the process terminates.

Turning again to step **716**, if additional search terms are present, the process returns to step **706** as described above. Referring again to step **714**, if the document parsing is not complete, the process returns to  
10 step **708** as described above. With reference to step **710**, if a search term is not found, the process proceeds to step **714** as described above.

Thus, the present invention provides an improved method, apparatus, and computer instructions for  
15 enhancing Web searches. This advantage is provided through a highlighting or emphasis mechanism in the browser, which highlights search terms present within a Web page. This mechanism allows for highlighting of search terms without requiring changes to the HTML  
20 document stored on the server. Further, no modifications to search engines are required. This mechanism may be implemented directly within the browser or through a plug-in.

It is important to note that while the present  
25 invention has been described in the context of a fully functioning data processing system, those of ordinary skill in the art will appreciate that the processes of the present invention are capable of being distributed in the form of a computer readable medium of instructions  
30 and a variety of forms and that the present invention applies equally regardless of the particular type of signal bearing media actually used to carry out the

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distribution. Examples of computer readable media include recordable-type media, such as a floppy disk, a hard disk drive, a RAM, CD-ROMs, DVD-ROMs, and transmission-type media, such as digital and analog communications links, wired or wireless communications links using transmission forms, such as, for example, radio frequency and light wave transmissions. The computer readable media may take the form of coded formats that are decoded for actual use in a particular data processing system.

The description of the present invention has been presented for purposes of illustration and description, and is not intended to be exhaustive or limited to the invention in the form disclosed. Many modifications and variations will be apparent to those of ordinary skill in the art. Although the depicted examples illustrate a search query in the form of a keyword search, the mechanism of the present invention may be applied to any type of search. For example, the highlighting may be applied to a phrase search, which is a search for documents containing an exact sentence or phrase specified by a user. In this case, the entire sentence or phrase is highlighted. Further, the mechanism of the present invention may be applied to other types of markup languages, other than HTML. For example, this process may be applied to extensible markup language (XML) documents.

The embodiment was chosen and described in order to best explain the principles of the invention, the practical application, and to enable others of ordinary skill in the art to understand the invention for various

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embodiments with various modifications as are suited to the particular use contemplated.

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